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DERWENT-ACC-NO: 1997-251242
DERWENT-WEEK: 199723

103

TITLE: Plasma etching with less etching rate fluctuation - includes cleaning process using gas containing fluorine@, conditioning and etching using gas containing chlorine@

Nawata et al.

PRIORITY-DATA:
1995JP-0241267 September 20, 1995

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 09082690 A	March 28, 1997	N/A	005	H01L021/3065

INT-CL (IPC): C23F 4/00; H01L 21/304; H01L 21/3065; H05H 1/46

ABSTRACTED-PUB-NO: JP09082690A
BASIC-ABSTRACT:

Plasma etching is achieved by: (1) cleaning using gas containing F; (2) conditioning using plasma of etching gas using Si substrate; and (3) etching using C12 or mixed gas of C12 or mixed gas of C12 and 02.

ADVANTAGE - The plasma etching can suppress the fluctuation of etching rate to improve uniformitv between wafers.

L9 ANSWER 2 OF 5 JAPIO COPYRIGHT 2000 JPO
AN 1997-082690 JAPIO
TI PLASMA **ETCHING** METHOD
IN NAWATA MAKOTO; YAKUSHIJI MAMORU; TSUKUNI KAZUYUKI; YAMAZAKI KAZUO
PA HITACHI LTD, JP (CO 000510)
PI **JP 09082690** A 19970328 Heisei
AI JP1995-241267 (JP07241267 Heisei) 19950920
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 97, No. 3
IC ICM (6) H01L021-3065
ICS (6) C23F004-00; (6) H01L021-304; (6) H05H001-46
AB PURPOSE: TO BE SOLVED:To restrain **cleaned silicon** and an **oxide** film (**SiO2**) as a ground film from varying in **etching** rate so as to improve **wafers** in uniformity. CONSTITUTION: oning is carried out with plasma of **C12** gas by the use of a **silicon** substrate after **cleaning** to reduce the influence of **residues** left inside a **cleaned** processing chamber after **cleaning**, and furthermore processing (**C12** gas discharge) is carried out with **C12** plasma by the use of a substrate which comprises an **Si** substrate and an **oxide** film formed on it to reduce the influence of **residues** left inside the processing chamber after **seasoning**.

TI Plasma **etching** of **silicon** semiconductor **wafer** including **seasoning**

IN Nawata, Makoto; Yakushiji, Mamoru; Tsukuni, Kazuyuki; Yamazaki, Kazuo
PA Hitachi, Ltd., Japan

SO Jpn. Kokai Tokkyo Koho, 5 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
IC ICM H01L021-3065
ICS C23F004-00; H01L021-304; H05H001-46
CC 76-3 (Electric Phenomena)
FAN.CNT 1

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI JP 09082690	A2	19970328	JP 1995-241267	19950920 <--

(Si-Cl or Si-Cl-O) seasoning film inherently forms

AB The method involves the following steps; (1) **cleaning** the **etching** app. with a F-contg. gas plasma, (2) **seasoning** by supplying Cl2 (and optionally O2) to **etch** a (**polycryst.**) **Si** or a **silicide** at .ltoreq.20 mTorr, (3) **seasoning** by supplying a **etching** gas plasma to **etch** a **Si** substrate, (4) treatment of a **Si** substrate having a **SiO2** film coating with a **Cl2** plasma, and (5) **etching** of a **Si** semiconductor **wafer**. The pre- and post **cleaning** of the app. inhibits dropping of the **etching** rate in **etching** of **Si** - and **Si oxide** films.

ST plasma **etching** app **cleaning**; **silicon** semiconductor **wafer** plasma **etching** app; **seasoning** plasma **etching** app **cleaning**

IT Plasma **etching**
Semiconductor materials
(plasma **etching** of **silicon** semiconductor **wafer** including **cleaning** and **seasoning**)

IT 2551-62-4, Sulfur hexafluoride 7782-41-4, Fluorine, uses 7782-44-7, Oxygen, uses 7782-50-5, Chlorine, uses 7783-54-2, Nitrogen trifluoride 7790-91-2, Chlorine fluoride (ClF3) 13709-36-9, Xenon difluoride
RL: NUU (Nonbiological use, unclassified); USES (Uses)
(**etchant**; in plasma **etching** of **silicon** semiconductor **wafer** including **cleaning** and **seasoning**)

IT 7440-21-3, **Silicon**, processes
RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)
(plasma **etching** of **silicon** semiconductor **wafer** including **cleaning** and **seasoning**)

IT 7631-86-9, **Silicon** dioxide, processes
RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)
(primer coatings; plasma **etching** of **silicon** semiconductor **wafer** including **cleaning** and **seasoning**)

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特開平9－82690

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Ｈ０１Ｌ　21/304	３４１		Ｈ０１Ｌ　21/304	３４１Ｄ	
Ｈ０５Ｈ　1/46			Ｈ０５Ｈ　1/46	Ｂ	
			Ｈ０１Ｌ　21/302	Ｆ	

審査請求　未請求　請求項の数９　ＯＬ　（全５頁）

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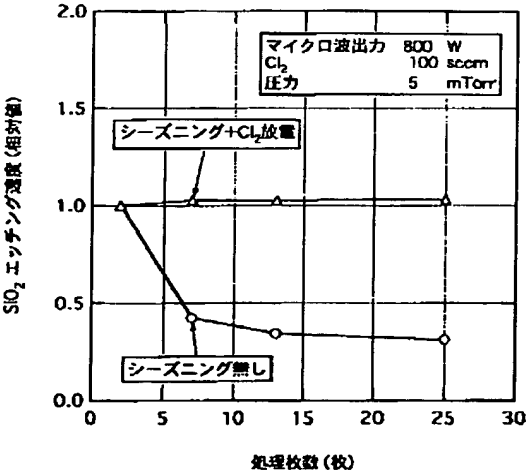
最終頁に続く

(54)【発明の名称】　プラズマエッチング方法

(57)【要約】
【目的】クリーニング後のシリコン及び下地膜である酸化膜（SiO_2）のエッチング速度の変化を抑制しウエハ間の均一性を向上させる。
【構成】クリーニング後にシリコン基板を用いてCl_2ガスプラズマでシーズニングを行い、クリーニング後の処理室内の残留物の影響を減少させ、さらにＳｉ基板上に酸化膜（SiO_2）を形成した基板を用いてCl_2プラズマによる処理（Cl_2放電）を行い、シーズニング後の処理室内の残留物の影響を減少させる。

図１



1

【特許請求の範囲】

【請求項１】フッ素を含むガスプラズマによりクリーニングを行い、クリーニング後、塩素ガス（Cl_2）の単独ガスあるいは塩素ガス（Cl_2）と酸素ガス（O_2）の混合ガスをエッチングガスとして用い、ガス圧力２０ｍＴｏｒｒ以下でシリコン，多結晶シリコンまたはシリサイドのエッチングを行うエッチング装置において、クリーニング後にシリコン（Ｓｉ）基板を用いてエッチングガスのプラズマで馴らし放電を行い、さらにＳｉ基板上に酸化膜（SiO_2）を形成した基板を用いてCl_2プラズマによる処理を行った後エッチングを開始することを特徴とするプラズマエッチング方法。

【請求項２】請求項１記載のプラズマエッチング方法において、前記フッ素を含むガスプラズマによるクリーニング，馴らし放電およびCl_2プラズマ処理を行った後エッチングを開始する前に前記被処理基板と同一のパターンを形成したシリコン基板および酸化膜基板を１枚づつダミーエッチングするプラズマエッチング方法。

【請求項３】請求項２記載のダミーエッチングにおいて、前記シリコン基板の処理時間をエッチング処理を行う前記被処理基板のジャストエッチング時間とし、酸化膜基板の処理時間をエッチング処理を行う前記被処理基板のオーバーエッチング時間とするプラズマエッチング方法。

【請求項４】請求項１記載の前記フッ素を含むガスが六フッ化硫黄（SF_6），三フッ化窒素（NF_3），二フッ化キセノン（XeF_2），フッ素（F_2），三フッ化塩素（ClF_3）の単独ガスあるいは混合ガスであるプラズマエッチング方法。

【請求項５】請求項１記載の前記馴らし放電において、ＳｉＦの発光スペクトルをモニターし、該発光スペクトルの強度の時間変化が一定値以下になった時点で、馴らし放電を終了しエッチングを開始するプラズマエッチング方法。

【請求項６】請求項１記載の前記馴らし放電において、Ｓｉ表面に酸化膜（SiO_2）を形成した基板或いは石英基板を用い、プロセスガスとしてCl_2と$SiCl_4$の混合ガスを使用するプラズマエッチング方法。

【請求項７】請求項１記載の前記Cl_2プラズマ処理において、Ｓｉの発光スペクトルをモニターし、該発光スペクトルの強度の時間変化が一定値以下になった時点で、Cl_2プラズマ処理を終了しエッチングを開始するプラズマエッチング方法。

【請求項８】請求項１記載の前記Cl_2プラズマ処理において、石英基板を用いるプラズマエッチング方法。

【請求項９】請求項１記載のプラズマエッチング方法において、エッチング開始時の放電管の温度あるいは処理室の温度を１００℃以上とするプラズマエッチング方法。

【発明の詳細な説明】

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【０００１】

【産業上の利用分野】本発明はプラズマエッチング方法に係り、特に、シリコン，多結晶シリコンまたはシリサイドのエッチングに好適なプラズマエッチング方法に関するものである。

【０００２】

【従来の技術】従来、平塚豊著，「ドライプロセス装置のチャンバクリーニング」，洗浄設計１９９２．Ｓｕｍｍｅｒ，Ｐ４１－５３に記載のように、エッチング等のプラズマプロセスでは、ウエハの粒子汚染を防止するためにクリーニングを行い、クリーニング後の処理室内の残留物をなくすためにポストクリーニングを行っている。SF_6，NF_3ガスをクリーニングに用いた場合にはN_2，Ａｒ，H_2，O_2ガスプラズマがポストクリーニングに用いられている。

【０００３】

【発明が解決しようとする課題】従来のエッチング方法では、クリーニング後の処理室内の残留物のエッチング特性に及ぼす影響について考慮されておらず、クリーニング後処理枚数とともにシリコン及び下地膜の酸化膜のエッチング速度が減少し、下地酸化膜の残膜が変動するという問題点があった。

【０００４】本発明の目的は、クリーニング後のシリコン及び酸化膜のエッチング速度の減少を抑制し下地酸化膜の残膜の変動を防止し良好なウエハ間の均一性が得られるエッチング方法を提供することにある。

【０００５】

【課題を解決するための手段】上記目的は、クリーニング後にエッチングガスであるCl_2あるいはCl_2とO_2の混合ガスプラズマによりダミーのシリコン基板を用いて馴らし放電（シーズニング）を行い、次に、馴らし放電後にシリコン表面に酸化膜を形成したダミーのシリコン基板或いは石英基板を用いてCl_2ガスプラズマ処理（Cl_2放電）を行ない、その後に所定のエッチング処理を行なうようにすることにより、達成される。

【０００６】

【作用】まず、クリーニング後にエッチングガスであるCl_2あるいはCl_2とO_2の混合ガスプラズマによって馴らし放電（シーズニング）を行なうことにより、クリーニング後の処理室内の残留フッ素の影響を減少させることができ、次に馴らし放電後にCl_2ガスプラズマによってCl_2プラズマ処理を行なうことによって、馴らし放電後の処理室内のシリコンの反応生成物の影響を減少させることができ、クリーニング後のシリコン及び酸化膜のエッチング速度の減少を抑制し下地酸化膜の残膜の変動を防止して良好なウエハ間の均一性を得られる。

【０００７】

【実施例】まず、図４に、SF_6ガスプラズマでクリーニングを行った後、Cl_2ガスプラズマでシリコンをエッチングした場合におけるＳｉＦ（波長４４１ｎｍ）の

発光スペクトルの処理枚数による変化を示す。シリコンとフッ素の反応によって生成するＳｉＦの発光スペクトルの強度は処理枚数とともに減少しほぼ一定となる。このことからフッ素を含むガスによるクリーニング後、処理室内にはフッ素が残留していることが分かった。図５、図６に、Cl_2ガスにSF_6ガスを添加した場合のＳｉＦの発光スペクトルとシリコン及び酸化膜のエッチング速度の変化を示す。図５、図６に示すようにSF_6の添加量の増加とともにＳｉＦ（波長４４１ｎｍ）の発光スペクトルの強度は増加する。SF_6の添加量の増加とともにシリコン及び酸化膜のエッチング速度は増加する。このことから残留フッ素によりシリコン及び酸化膜のエッチング速度は変動し、残留フッ素の減少とともにシリコン及び酸化膜のエッチング速度が低下することを見出した。

【０００８】前述のCl_2ガスプラズマによるシリコンのエッチングは、クリーニング後の馴らし放電、すなわち、シーズニングに相当する。シーズニング後の処理室内にはシリコン系の反応生成物（ＳｉあるいはＳｉＣｌｘ）が残留していることがＳｉの発光スペクトルからわかった。図７に、Cl_2ガスに$SiCl_4$ガスを添加した場合の酸化膜のエッチング速度の変化を示す。酸化膜のエッチング速度は$SiCl_4$の添加量の増加とともに減少する。このシリコン系の反応生成物のためにシーズニング直後のシリコン酸化膜のエッチング速度が減少していることを見出した。

【０００９】上述のこれらにより、フッ素を含むプラズマによるクリーニング後にシーズニングを行い、クリーニング後の処理室内に残留するフッ素の除去を行うことにより、シリコン及び酸化膜のエッチング速度の変動を抑制でき、さらにシーズニング後にCl_2ガスを用いたプラズマ処理、すなわち、Cl_2放電を行い、シーズニング後の処理室内に残留するシリコンの反応生成物の除去を行うことにより、酸化膜のエッチング速度の変動を抑制できることを見出した。

【００１０】以下、本発明の一実施例を図１ないし図３により説明する。図３は、本発明の方法を実施するためのプラズマ処理装置の一例であるマイクロ波プラズマエッチング装置の概略を示した図である。マグネトロン１から発振したマイクロ波は導波管２を伝播し石英製放電管３を介して処理室４に導かれる。磁界発生用直流電源５からソレノイドコイル６，７に供給される直流電流によって形成される磁界とマイクロ波電界によってエッチングガス供給装置８から供給されるクリーニングガス（SF_6），シーズニングガス（Cl_2ガス），Cl_2放電ガス（Cl_2）及びエッチングガス（Cl_2ガス）は、それぞれのステップでプラズマ化される。

【００１１】まず、SF_6ガスプラズマにより処理室４のクリーニングが行われる。その後、シリコン基板を用いてCl_2ガスプラズマにより処理室４のシーズニング

が行われる。さらにシリコン表面に酸化膜を形成したシリコン基板或いは石英基板を用いてCl_2放電が行われる。クリーニング、シーズニング、Cl_2放電の後、Cl_2ガスにより載置電極９に載置されているウエハ１０のエッチングが行われる。クリーニング、シーズニング、Cl_2放電及びエッチング時の圧力は真空排気装置１１によって制御される。また、ウエハに入射するイオンのエネルギは載置電極９に高周波電源１２から供給される高周波電力によって制御される。

【００１２】図１、図２にシーズニングの無い場合とシーズニングとCl_2放電を行った場合のシリコン及び酸化膜のエッチング速度の変化の違いを示す。シーズニングはCl_2ガスプラズマにより行い、ＳｉＦの発光スペクトルを１０秒毎にモニタし時間ｔ(n)と時間ｔ(n-1)に測定したスペクトルの発光強度比が１±０．００２になった時点でシーズニングを停止した。クリーニング後にシーズニングを行うことによりクリーニング時に生成されるフッ素の残留の影響を抑制しエッチング速度の変動を防止できる。Cl_2放電は高周波電力を印加せずCl_2ガスプラズマによりシリコンの反応生成物の除去を行う。Ｓｉの発光スペクトルを１０秒毎にモニタし時間ｔ(n)と時間ｔ(n-1)に測定したスペクトルの発光強度比が１±０．００２になった時点でCl_2放電を停止した。シーズニング後にCl_2放電を行うことによりシーズニング時に生成されるシリコンの反応生成物の残留の影響を抑制し下地酸化膜のエッチング速度の変動を防止できる。

【００１３】本実施例によれば、クリーニング後の残留フッ素の影響を抑制しシリコン及び酸化膜のエッチング速度の変動を防止することができる。また、シーズニング後のシリコンの反応生成物の影響を抑制し下地酸化膜のエッチング速度の変動を防止することができる。

【００１４】本実施例ではマイクロ波プラズマエッチング装置についてその効果を説明したが、他の放電方式例えばプラズマエッチング（ＰＥ）、ヘリコン、ＴＣＰ(Transformer Coupled Plasma)においても同様な効果が得られる。

【００１５】

【発明の効果】本発明によれば、クリーニング後の残留フッ素及びシーズニング後のシリコンの反応生成物の影響を抑制しシリコン及び酸化膜のエッチング速度の変動を防止することができるという効果がある。

【図面の簡単な説明】

【図１】本発明の一実施例におけるSiO_2エッチング速度の処理枚数依存性を示す図である。

【図２】本発明の一実施例におけるＳｉエッチング速度の処理枚数依存性を示す図である。

【図３】本発明の方法を実施するための装置の一例を示すマイクロ波プラズマエッチング装置の構成を示す図である。

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【図４】ＳｉＦ発光強度の処理枚数依存性示す図である。

【図５】ＳｉＦ発光強度のＳＦ$_6$添加量依存性を示す図である。

【図６】Ｓｉ及びＳｉＯ$_2$エッチング速度のＳＦ$_6$添加量依存性を示す図である。

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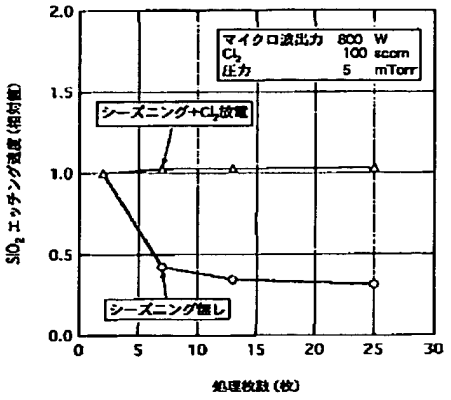
【図７】ＳｉＯ$_2$エッチング速度のＳｉＣｌ$_4$添加量依存性を示す図である。

【符号の説明】

３…石英製放電管、６，７…ソレノイドコイル、８…エッチングガス供給装置、１０…ウエハ。

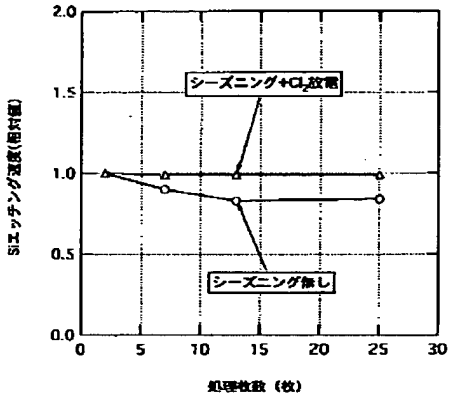
【図１】

図 1



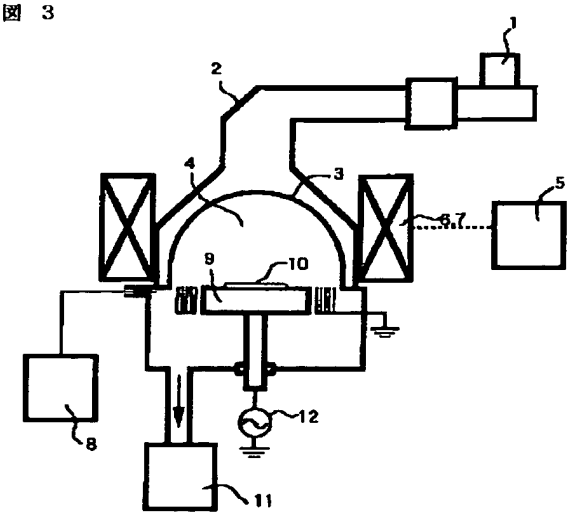
【図２】

図 2



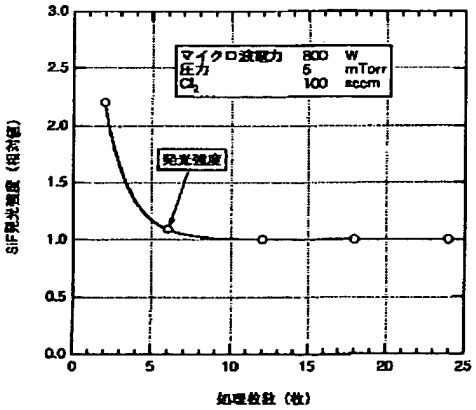
【図３】

図 3



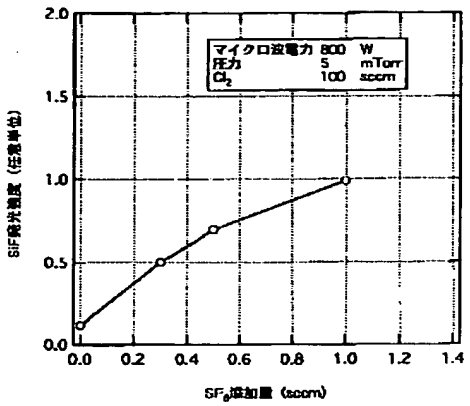
【図４】

図 4



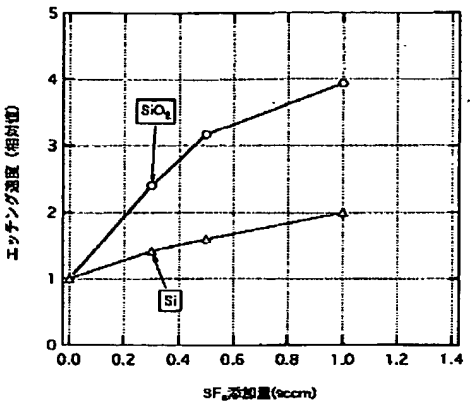
【図5】

図 5



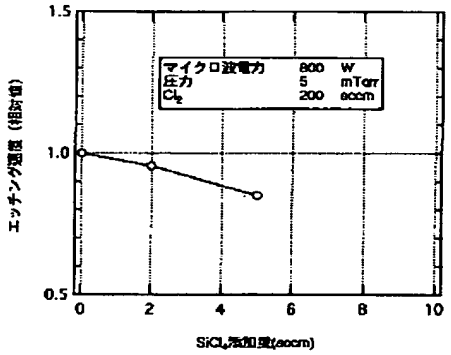
【図6】

図 6



【図7】

図 7



フロントページの続き

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09-082,690

* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] It cleans by the gas plasma containing a fluorine. After cleaning, The mixed gas of the independent gas of chlorine gas (Cl2) or chlorine gas (Cl2), and oxygen gas (O2) is used as etching gas. In the etching system which performs etching of silicon, polycrystal silicon, or a silicide with 20 or less mTorr of gas pressure The plasma-etching technique characterized by starting etching after performing processing by Cl2 plasma using the substrate which discharged by having used the silicon (Si) substrate and having accustomed with the plasma of etching gas after cleaning, and formed the oxide film (SiO2) on Si substrate further.
[Claim 2] The plasma-etching technique which carries out dummy etching of every one silicon substrate and oxide-film substrate which formed the same pattern as the aforementioned processed substrate before starting etching, after performing cleaning by the gas plasma containing the aforementioned fluorine, training electric discharge, and Cl2 plasma treatment in the plasma-etching technique according to claim 1.
[Claim 3] The plasma-etching technique which makes the processing time of the aforementioned silicon substrate the just-etching time of the aforementioned processed substrate which performs etching processing in dummy etching according to claim 2, and makes the processing time of an oxide-film substrate the over etching time of the aforementioned processed substrate which performs etching processing.
[Claim 4] The plasma-etching technique that the gas containing the aforementioned fluorine according to claim 1 is the independent gas or mixed gas of 2 3 fluoride [6 fluoride / sulfur / (SF6) and nitrogen] (NF3) and xenon fluoride (XeF2), a fluorine (F2), and 3 fluoride-salt ** (ClF3).
[Claim 5] The plasma-etching technique which ends training electric discharge and starts etching when it acts as the monitor of the emission spectrum of SiF and time change of the intensity of this emission spectrum becomes below a constant value in the aforementioned training electric discharge according to claim 1.
[Claim 6] The plasma-etching technique which uses the mixed gas of Cl2 and SiCl4 as process gas in the aforementioned training electric discharge according to claim 1 using the substrate or the quartz substrate in which the oxide film (SiO2) was formed on Si front face.
[Claim 7] The plasma-etching technique which ends Cl2 plasma treatment and starts etching when it acts as the monitor of the emission spectrum of Si and time change of the intensity of this emission spectrum becomes below a constant value in the aforementioned Cl2 plasma treatment according to claim 1.
[Claim 8] The plasma-etching technique using [on the aforementioned Cl2 plasma treatment according to claim 1 and] a quartz substrate.
[Claim 9] The plasma-etching technique which makes temperature of the discharge tube at the time of etching start, or temperature of a processing room 100 degrees C or more in the plasma-etching technique according to claim 1.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] this invention relates to the plasma-etching technique, and relates to silicon, polycrystal silicon, or the suitable plasma-etching technique for etching of a silicide especially.
[0002]
[Description of the Prior Art] Conventionally, like the publication to Hiratsuka **** and "chamber cleaning of dry-process equipment" washing design 1992.Summer, and P41-53, in plasma processes, such as etching, it cleans in order to prevent grain contamination of a wafer, and in order to lose the residue of the processing interior of a room after cleaning, post cleaning is performed. When SF6 and NF3 gas are used for cleaning, N2, Ar, H2, and O2 gas plasma are used for post cleaning.
[0003]
[Problem(s) to be Solved by the Invention] By the conventional etching technique, it was not taken into consideration about the influence affect the etching property of the residue of the processing interior of a room after cleaning, but the etch rate of the oxide film of silicon and a substratum layer decreased with cleaning after-treatment number of sheets, and there was a trouble of changing **** of a substratum oxide film.
[0004] The purpose of this invention is to offer the etching technique by which a decrement of the silicon after cleaning and the etch rate of an oxide film is suppressed, change of **** of a substratum oxide film is prevented, and the homogeneity between good wafers is acquired.
[0005]
[Means for Solving the Problem] The above-mentioned purpose is attained by performing Cl2 gas plasma treatment (Cl2 electric discharge) using the silicon substrate or quartz substrate of a dummy which discharged by having accustomed after cleaning using the silicon substrate of a dummy by Cl2 or the mixed-gas plasma of Cl2 and O2 which is etching gas (seasoning), next formed the oxide film in the silicon front face after training electric discharge, and being made to perform predetermined etching processing after that.
[0006]
[Function] First, by discharging by accustoming after cleaning by Cl2 or the mixed-gas plasma of Cl2 and O2 which is etching gas (seasoning) By being able to decrease the influence of the remains fluorine of the processing interior of a room after cleaning, accustoming to a degree, and performing Cl2 plasma treatment by Cl2 gas plasma after electric discharge The influence of the resultant of the silicon of the processing interior of a room after training electric discharge can be decreased, a decrement of the silicon after cleaning and the etch rate of an oxide film is suppressed, change of **** of a substratum oxide film is prevented, and the homogeneity between good wafers can be acquired.
[0007]
[Example] First, after cleaning to drawing 4 with SF6 gas plasma, change by the processing number of sheets of the emission spectrum of SiF (wavelength of 441nm) at the time of etching silicon with Cl2 gas plasma is shown in it. The intensity of the emission spectrum of SiF generated by the reaction of silicon and a fluorine decreases with processing number of sheets, and becomes almost fixed. The processing interior of a room found that the fluorine remained after cleaning by the gas which contains a fluorine from this. Change of the etch rate of the emission spectrum of SiF at the time of adding SF6 gas in Cl2 gas, silicon, and an oxide film is shown in drawing 5 and the drawing 6 . As shown in drawing 5 and the drawing 6 , the intensity of the emission spectrum of SiF (wavelength of 441nm) increases with the increase in the addition of SF6. The etch rate of silicon and an oxide film increases with the increase in the addition of SF6. The etch rate of silicon and an oxide film was changed by the remains fluorine from this, and it found out that the etch rate of silicon and an oxide film fell with a decrement of a remains fluorine.
[0008] Etching of the silicon by the above-mentioned Cl2 gas plasma is equivalent to the training electric discharge after cleaning, i.e., seasoning. The processing interior of a room after seasoning found that the resultant (Si or SiClx) of a silicon system remained from the emission spectrum of Si. Change of the etch rate of the oxide film at the time of adding SiCl4 gas in Cl2 gas is shown in drawing 7 . The etch rate of an oxide film decreases with the increase in the addition of SiCl4. The etch rate of the silicon oxide immediately after seasoning was found out decreasing for the resultant of this silicon system.
[0009] By removing the fluorine which performs seasoning after cleaning by the plasma containing a fluorine, and remains to the processing interior of a room after cleaning by these above-mentioned The plasma treatment which could suppress change of the etch rate of silicon and an oxide film, and used Cl2 gas after seasoning further, That is, Cl2 electric discharge was performed and

it found out that change of the etch rate of an oxide film could be suppressed by removing the resultant of the silicon which remains to the processing interior of a room after seasoning.

[0010] Hereafter, the drawing 1 or the drawing 3 explains one example of this invention. Drawing 3 is drawing having shown the outline of the microwave plasma etching system which is an example of the plasma-treatment equipment for enforcing the technique of this invention. The microwave oscillated from the magnetron 1 spreads a waveguide 2, and is led to the processing room 4 through the discharge tube made from a quartz 3. The cleaning gas (SF6) supplied by the magnetic field formed of the direct current supplied to solenoid coils 6 and 7 from DC power supply for magnetic-field occurrence 5 and the microwave electric field from the etching gas supply system 8, seasoning gas (Cl2 gas), Cl2 discharge gas (Cl2), and etching gas (Cl2 gas) are plasma-ized at each step.

[0011] First, cleaning of the processing room 4 is performed by SF6 gas plasma. Then, seasoning of the processing room 4 is performed by Cl2 gas plasma using a silicon substrate. Cl2 electric discharge is performed using the silicon substrate or quartz substrate which furthermore formed the oxide film in the silicon front face. Etching of the wafer 10 currently laid in the installation electrode 9 by Cl2 gas is performed after cleaning, seasoning, and Cl2 electric discharge. The pressure at the time of cleaning, seasoning, Cl2 electric discharge, and etching is controlled by the evacuation equipment 11. Moreover, the energy of the ion which carries out incidence to a wafer is controlled by RF power supplied to the installation electrode 9 from RF generator 12.

[0012] The difference in change of the silicon at the time of performing the case where there is no seasoning, seasoning, and Cl2 electric discharge, and the etch rate of an oxide film is shown in drawing 1 and the drawing 2 . Cl2 gas plasma performed seasoning, and seasoning was suspended when the photogenesis intensity ratio of the spectrum which carried out the monitor of the emission spectrum of SiF every 10 seconds, and was measured to time t (n) and time t (n-1) was set to 1**0.002. By performing seasoning after cleaning, the influence of remains of the fluorine generated at the time of cleaning is suppressed, and change of an etch rate can be prevented. Cl2 electric discharge does not impress RF power, but removes the resultant of silicon by Cl2 gas plasma. When the photogenesis intensity ratio of the spectrum which carried out the monitor of the emission spectrum of Si every 10 seconds, and was measured to time t (n) and time t (n-1) was set to 1**0.002, Cl2 electric discharge was stopped. By performing Cl2 electric discharge after seasoning, the influence of remains of the resultant of the silicon generated at the time of seasoning is suppressed, and change of the etch rate of a substratum oxide film can be prevented.

[0013] According to this example, the influence of the remains fluorine after cleaning can be suppressed, and change of the etch rate of silicon and an oxide film can be prevented. Moreover, the influence of the resultant of the silicon after seasoning can be suppressed, and change of the etch rate of a substratum oxide film can be prevented.

[0014] Although this example explained the effect about the microwave plasma etching system, the same effect is acquired also in other electric discharge methods (PE), for example, a plasma etching, Helicon, and TCP (Transformer Coupled Plasma).

[0015]

[Effect of the Invention] According to this invention, the influence of the resultant of the remains fluorine after cleaning and the silicon after seasoning is suppressed, and it is effective in the ability to prevent change of the etch rate of silicon and an oxide film.

[Translation done.]

* NOTICES *

Field

[Field of the Invention] this invention relates to the plasma-etching technique, and relates to silicon, polycrystal silicon, or the suitable plasma-etching technique for etching of a silicide especially.

[Translation done.]

* NOTICES *

Technique

[Description of the Prior Art] Conventionally, like the publication to Hiratsuka **** and "chamber cleaning of dry-process equipment" washing design 1992.Summer, and P41-53, in plasma processes, such as etching, it cleans in order to prevent grain contamination of a wafer, and in order to lose the residue of the processing interior of a room after cleaning, post cleaning is performed. When SF6 and NF3 gas are used for cleaning, N2, Ar, H2, and O2 gas plasma are used for post cleaning.

[Translation done.]

* NOTICES *

Effect

[Effect of the Invention] According to this invention, the influence of the resultant of the remains fluorine after cleaning and the silicon after seasoning is suppressed, and it is effective in the ability to prevent change of the etch rate of silicon and an oxide film.

[Translation done.]

* NOTICES *

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the conventional etching technique, it was not taken into consideration about the influence affect the etching property of the residue of the processing interior of a room after cleaning, but the etch rate of the oxide film of silicon and a substratum layer decreased with cleaning after-treatment number of sheets, and there was a trouble of changing **** of a substratum oxide film.
[0004] The purpose of this invention is to offer the etching technique by which a decrement of the silicon after cleaning and the etch rate of an oxide film is suppressed, change of **** of a substratum oxide film is prevented, and the homogeneity between good wafers is acquired.

[Translation done.]

* NOTICES *

MEANS

[Means for Solving the Problem] The above-mentioned purpose is attained by performing Cl2 gas plasma treatment (Cl2 electric discharge) using the silicon substrate or quartz substrate of a dummy which discharged by having accustomed after cleaning using the silicon substrate of a dummy by Cl2 or the mixed-gas plasma of Cl2 and O2 which is etching gas (seasoning), next formed the oxide film in the silicon front face after training electric discharge, and being made to perform predetermined etching processing after that.

[Translation done.]

* NOTICES *

OPERATION

[Function] First, by discharging by accustoming after cleaning by Cl2 or the mixed-gas plasma of Cl2 and O2 which is etching gas (seasoning) By being able to decrease the influence of the remains fluorine of the processing interior of a room after cleaning, accustoming to a degree, and performing Cl2 plasma treatment by Cl2 gas plasma after electric discharge The influence of the resultant of the silicon of the processing interior of a room after training electric discharge can be decreased, a decrement of the silicon after cleaning and the etch rate of an oxide film is suppressed, change of **** of a substratum oxide film is prevented, and the homogeneity between good wafers can be acquired.

[Translation done.]

* NOTICES *

EXAMPLE

[Example] First, after cleaning to drawing 4 with SF6 gas plasma, change by the processing number of sheets of the emission spectrum of SiF (wavelength of 441nm) at the time of etching silicon with Cl2 gas plasma is shown in it. The intensity of the emission spectrum of SiF generated by the reaction of silicon and a fluorine decreases with processing number of sheets, and becomes almost fixed. The processing interior of a room found that the fluorine remained after cleaning by the gas which contains a fluorine from this. Change of the etch rate of the emission spectrum of SiF at the time of adding SF6 gas in Cl2 gas, silicon, and an oxide film is shown in drawing 5 and the drawing 6 . As shown in drawing 5 and the drawing 6 , the intensity of the emission spectrum of SiF (wavelength of 441nm) increases with the increase in the addition of SF6. The etch rate of silicon and an oxide film increases with the increase in the addition of SF6. The etch rate of silicon and an oxide film was changed by the remains fluorine from this, and it found out that the etch rate of silicon and an oxide film fell with a decrement of a remains fluorine.
[0008] Etching of the silicon by the above-mentioned Cl2 gas plasma is equivalent to the training electric discharge after cleaning, i.e., seasoning. The processing interior of a room after seasoning found that the resultant (Si or SiClx) of a silicon system remained from the emission spectrum of Si. Change of the etch rate of the oxide film at the time of adding SiCl4 gas in Cl2 gas is shown in drawing 7 . The etch rate of an oxide film decreases with the increase in the addition of SiCl4. The etch rate of the silicon oxide immediately after seasoning was found out decreasing for the resultant of this silicon system.
[0009] By removing the fluorine which performs seasoning after cleaning by the plasma containing a fluorine, and remains to the processing interior of a room after cleaning by these above-mentioned The plasma treatment which could suppress change of the etch rate of silicon and an oxide film, and used Cl2 gas after seasoning further, That is, Cl2 electric discharge was performed and it found out that change of the etch rate of an oxide film could be suppressed by removing the resultant of the silicon which remains to the processing interior of a room after seasoning.
[0010] Hereafter, the drawing 1 or the drawing 3 explains one example of this invention. Drawing 3 is drawing having shown the outline of the microwave plasma etching system which is an example of the plasma-treatment equipment for enforcing the technique of this invention. The microwave oscillated from the magnetron 1 spreads a waveguide 2, and is led to the processing room 4 through the discharge tube made from a quartz 3. The cleaning gas (SF6) supplied by the magnetic field formed of the direct current supplied to solenoid coils 6 and 7 from DC power supply for magnetic-field occurrence 5 and the microwave electric field from the etching gas supply system 8, seasoning gas (Cl2 gas), Cl2 discharge gas (Cl2), and etching gas (Cl2 gas) are plasma-ized at each step.
[0011] First, cleaning of the processing room 4 is performed by SF6 gas plasma. Then, seasoning of the processing room 4 is performed by Cl2 gas plasma using a silicon substrate. Cl2 electric discharge is performed using the silicon substrate or quartz substrate which furthermore formed the oxide film in the silicon front face. Etching of the wafer 10 currently laid in the installation electrode 9 by Cl2 gas is performed after cleaning, seasoning, and Cl2 electric discharge. The pressure at the time of cleaning, seasoning, Cl2 electric discharge, and etching is controlled by the evacuation equipment 11. Moreover, the energy of the ion which carries out incidence to a wafer is controlled by RF power supplied to the installation electrode 9 from RF generator 12.

[0012] The difference in change of the silicon at the time of performing the case where there is no seasoning, seasoning, and Cl2 electric discharge, and the etch rate of an oxide film is shown in drawing 1 and the drawing 2 . Cl2 gas plasma performed seasoning, and seasoning was suspended when the photogenesis intensity ratio of the spectrum which carried out the monitor of the emission spectrum of SiF every 10 seconds, and was measured to time t (n) and time t (n-1) was set to 1**0.002. By performing seasoning after cleaning, the influence of remains of the fluorine generated at the time of cleaning is suppressed, and change of an etch rate can be prevented. Cl2 electric discharge does not impress RF power, but removes the resultant of silicon by Cl2 gas plasma. When the photogenesis intensity ratio of the spectrum which carried out the monitor of the emission spectrum of Si every 10 seconds, and was measured to time t (n) and time t (n-1) was set to 1**0.002, Cl2 electric discharge was stopped. By performing Cl2 electric discharge after seasoning, the influence of remains of the resultant of the silicon generated at the time of seasoning is suppressed, and change of the etch rate of a substratum oxide film can be prevented.
[0013] According to this example, the influence of the remains fluorine after cleaning can be suppressed, and change of the etch rate of silicon and an oxide film can be prevented. Moreover, the influence of the resultant of the silicon after seasoning can be suppressed, and change of the etch rate of a substratum oxide film can be prevented.
[0014] Although this example explained the effect about the microwave plasma etching system, the same effect is acquired also in other electric discharge methods (PE), for example, a plasma etching, Helicon, and TCP (Transformer Coupled Plasma).

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the processing number-of-sheets dependency of SiO2 etch rate in one example of this invention.
[Drawing 2] It is drawing showing the processing number-of-sheets dependency of Si etch rate in one example of this invention.
[Drawing 3] It is drawing showing the configuration of the microwave plasma etching system which shows an example of the equipment for enforcing the technique of this invention.
[Drawing 4] It is the processing number-of-sheets dependency **** view of SiF photogenesis intensity.
[Drawing 5] It is drawing showing SF6 addition dependency of SiF photogenesis intensity.
[Drawing 6] It is drawing showing SF6 addition dependency of Si and SiO2 etch rate.
[Drawing 7] It is drawing showing SiCl4 addition dependency of SiO2 etch rate.
[Description of Notations]
3 [-- An etching gas supply system, 10 / -- Wafer.] -- The discharge tube made from a quartz, 6, 7 -- A solenoid coil, 8

[Translation done.]